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The study of a mini-medical image system with content indices

Hsin-Yi Chen, Shuenn-Tsong Young
Institute of Biomedical Engineering, National Yang-Ming University

Taipei, Taiwan, R.O.C.

Abstract- The study proposed a mini medical image system with content index for image retrieval, which content indices include the size, orientation, compactness, and edge characteristics of an image object. The system was built with abdominal CT images as testing material. The result proved the system is successful for the images with special interesting objects.

Ⅰ. INTRODUCTION

Due to the trend of medical image digitizing, medical image database will urgently be done. However, a lot of multimodality image data crowd into medical image database everyday and will be saved for a long time. The method of query is important to retrieve the interested image case efficiently from database. Now, the query is usually based on text associate with the image database in the hospital. The query indices include patient's ID, patient's name, accession number for image files, and so on. But if query basing on image content will be required, matching the annotation words for images is the only way. Because of this, the idea"content-based image indexing", was formed. Very few content-image databases have proposed since it is very difficult to define what contents are significant as the image indices. The study proposed a mini medical image system with the content indices for its image retrieval, which content indices include the size, orientation, compactness, and edge characteristics of an image object.

Ⅱ. MATERIALS AND METHODS

A. Image processing

The proposed mini-medical image system was built with semi-automatic structure. A medical image specialist (radiologist) was included within the operation of the system. A serial of abdomen CT images were acquired from the radiology information system automatically. The specialist then previewed the images, and selected the special interesting object from one of the serial images by a hand-drawing contour on the monitor. The system processed the image of the interesting object by contour finding, object segmentation, shape definition, orientation measurement, and compactness and edge characteristic calculation. The whole image processing was automatic, and an index list basing on the image content was achieved. The processing was applied to all the serial images, and finally all images were with their associate index lists. The specialist was asked to confirm such index lists. With the confirmation, all the index lists were used as the content indices for image retrieval, and an image database with content indices was accomplished.

B. Extracting of content indices

The proposed mini medical image system was applied with abdominal CT images as testing material. We used the CT images as the target image to extract their content indices. All of these CT images have some target on livers that were the object we were interested to study. The target was treat as so called “special interesting object”. The size, orientation, compactness and edge characteristics of the special object were extracted or calculated, and all these attributes consisted of the content indices of an image.

The size was defined as the area of the object. On the image, a virtual axis was drawn from the center of spine cord to the middle of the anterior plane. The image processing found out the centroid of the objects. There was also a virtual line drawn from the spine to the centroid. Two parameters defined the orientation of the object. The first was the angle between the virtual axis and virtual line. The second was the distance between the centroid and the spine cord. The curvature length of the object was calculated. The object area divided the square of the curvature length, and the compactness C1 of the object was obtained. The edge characteristic was much complex to define. A closing operation of morphology method was applied to the curvature of the special interesting object. The operation will smooth the curve edge of the object, and lessen its curvature length. With the modified curvature length, we had the other compactness C2. A parameter E was defined as (C1-C2)/C1, and it was used to describe the edge characteristics of the object.

C. System and development tools

The mini medical system was built on an image server with Windows 2000 operation. Sybase database was the database engine, and Labview programming kits was used to develop all the application programs.

Ⅱ.RESULTS

The size and the orientation of a special interesting object were easy to obtain, and they were also easily understood to be the content indices of an image object. They can be used to roughly retrieve an image database, but always selected images with different shape and characteristics. The compactness C1 and the edge characteristics E1 defined the image object with similar shape. The larger the compactness C1 was, the more

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Abstract

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irregular curvature of the object was. In the other hand, with the smaller E1, the shape of the object was more similar to a circle shape.

The system was built with a graph user interface. The medical image specialist can involve the system operation to find out the content indices of serial images semi-automatically (fig 2). He/her can also easily retrieve the interested images by enter certain content criterions. The content criterions can be set with flexible range and combination. For example, one can set retrieval criterions as the following: a liver image with target of size larger than $2mm^2$, located on the left leaf, and with smooth curve and near a circle shape. All the prescription was asked to input by a defined numeric value.

IV. Discussions and Conclusions

The study has built a mini medical image system with content indices for its image retrieval. The system cooperated with medical image specialists to extracting the content indices of medical image by semi-automatically. The extracted content indices included the size, the orientation, the compactness, and the edge characteristic of the special interesting object on the image. The performance of the system has been tested by the abdominal CT images. The result showed the selected content indices usually satisfied the need of medical image specialist. It can easily extract the relative images for reference.

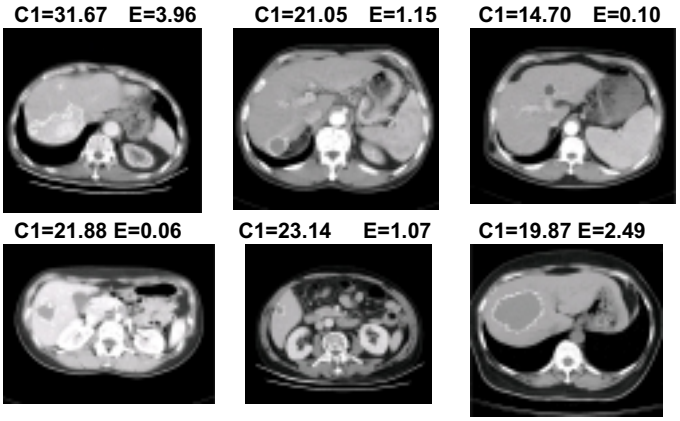

Figure 1: The compactness and edge characteristic

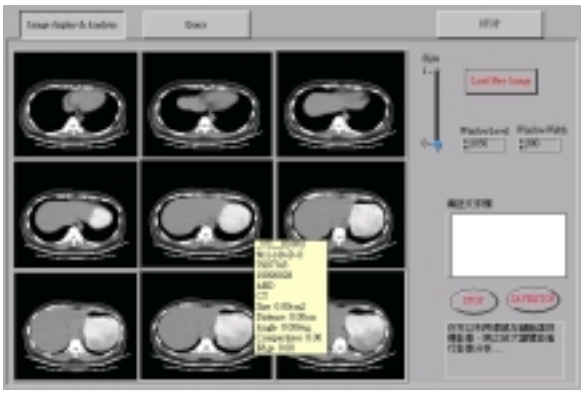

Figure 2: Interface for content indices extracting

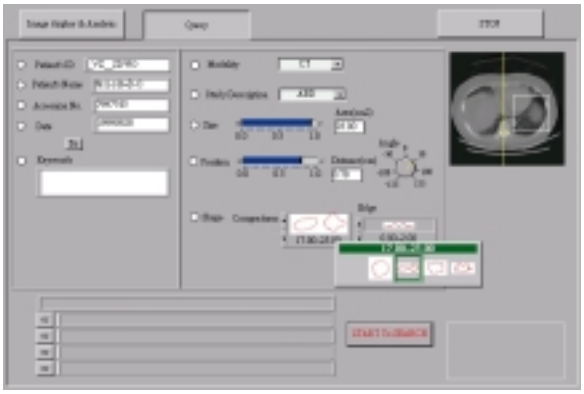

Figure 3: Interface for image retrieval by content indices

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